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The Editor's Page

DIRECTOR W. E. Yelland of U. S. Institute's warp sizing research at Massachusetts Institute of Technology, has received the degree of Ph.D. from that institution. Dr. Yelland qualified in organic chemistry, his thesis being on "A Study of Guanidonium and Related Bases."

THE study of trends in "Production and Distribution Organization in the Textile Industry" which was suggested by U. S. Institute's Committee on Economic Research, Fessenden S. Blanchard, chairman, and has been financed by the Textile Foundation for a sum not to exceed $20,000, has been placed with the Wharton School of Commerce and Finance, University of Pennsylvania. It will be conducted under the direction of Dean Jos. H. Willits, and associated in the work will be several members of the faculty and several graduates of the school who have had experience in textile economics. The study will be administered by the Committee on Economic Research of U. S. Institute, with the presidents of the four following textile associations acting in an advisory capacity: National Association of Wool Manufacturers, National Association of Cotton Manufacturers, National Federation of Textiles, and the Association of Cotton Textile Merchants of New York.

THE fourth confidential progress report of U. S. Institute's warp sizing research, and the first on the present phase of the study (the sizing of viscose-process rayons), will have been mailed to co-operators prior to publication of this issue. It has to do with preliminary laboratory work on materials, their analysis, etc. Experimental research in connection with actual processing is about to start at Pacific Mills where Director Yelland will have the personal advice of Chairman Wright Bolton of the Warp Sizing Administration Committee.

OF unusual interest and value to those who are seeking fundamental knowledge of starches and starch pastes are the results of research at Shirley Institute of the British Cotton Industry Research Association of Richardson, Higginbotham and Farrow, published in the May number of the *Journal of the Textile Institute*. It is confirmatory of certain of the results of U. S. Institute's basic research, particularly as to reducing power and acid hydrolysis, but much new knowledge is disclosed as to molecular chain-length and on correlation of the curves of reducing power and viscosity. An outline of the results of the study as contained in the introduction and summary of the report is reproduced with credit in this issue.

THE research report on "The Retentivity of Water by Purified Cotton Cellulose," by Homer A. Hamm and Prof. W. A. Patrick, published in this issue, treats one of the many fundamental problems that are basic to U. S. Institute's proposed study of textile drying. Under the conditions by which the adsorption of water vapor was studied by the authors it was

found that cellulose exhibited no hysteresis. Following further along the lines of their study they believe it possible to present a complete mechanism for the retention of vapor by porous bodies such as cellulose and other textile fibres and materials. They admit, however, that their ideas are limited to the adsorption of vapors and gases in the absence of specific chemical or adsorption effects. As the latter are frequently present in the drying of textile materials the practical application of their theories in textile drying may be limited.

To Publish New Book

A successor to U. S. Institute's book, Textile Research: A Survey of Progress, is to be compiled and published. Under the title "Textile Research Progress" it will review and interpret research in this and foreign countries for the five years from 1932 to 1936 inclusive, the period not covered by the first book which was published in 1932. A notable feature of the new book, in addition to its interpretative sections, will be its very complete bibliography of recent textile research throughout the world.

Publication of the new book was recommended by the Research Council to the Board of Directors at their joint meeting in New York City June 3. Compilation of the book, selection of authors, etc., are to be handled by the Board of Editors of this magazine: Prof. E. R. Schwarz, Chm., Prof. Louis A. Olney and Dr. W. E. Emley; printing and marketing by the magazine's Publication Committee: C. H. Clark, Chm., Ernest N. Hood and William W. Buffum.

Financing of Drying Research

THE Board of Directors of U. S. Institute at their meeting in New York City, June 3d, authorized Sec. C. H. Clark to undertake the co-operative financing of a research on textile drying under tht supervision of the committee appointed by the Research Council, May 6: Dr. W. E. Emley, Chm., Alban Eavenson and Dr. H. DeW. Smith. For a year's work on the project $5,000 is needed, and contributions are sought on a minimum basis of $100 each. It is hoped, however, that some firms will feel that the benefits likely to accrue from the study will justify larger contributions.

The Financing Plan

The plan for the financing is identical with that developed for the warp sizing study now in progress at Massachusetts Institute of Technology and co-operating mills. Those who co-operate in the financing at $100 a year will receive at no extra cost contributing membership ($100) in U. S. Institute for the period of their financing, and this membership qualifies them to receive confidential progress reports of not only this project, but of all U. S. Institute researches that are in progress during the same period. That is, if the warp sizing study continues after the drying study is started then co-operators in both will receive the confidential progress reports of both.

Plan Held Too Generous

At the June 3d meeting of the Board of Directors there was strong opposition to this generous arrangement, it being held that each project, its

financing and its benefits during its progress should be independent of other projects. Temporary continuation of the present arrangement was agreed to in the hope that it would stimulate a sufficient increase in regular contributing members to make available annually a sufficient surplus fund to finance much of U. S. Institute research without additional subscriptions, other than those that might be appropriated by the research foundations.

One-Fifth Subscribed

Following publication in the June issue of this magazine of a report of the drying conference, and the receipt by those who attended of the complete stenographic report of the discussion, subscriptions of $100 each toward the financing were received from ten firms, all of whom had representatives at the conference. This is encouraging, but those manufacturers who are conscious of the need and probable benefits of this study should realize that the sooner the project is financed and started the greater will be the services that U. S. Institute can give them under the generous provisions of the financing agreement. Until the financing is completed nothing will be done about the placing of the study, or completing the research program. Its general scope, however, is explained in the following outline prepared by the committee:

Need and Scope of Study

"The ultimate goal for this work is to provide sufficient information so that any kind of textile material can be dried with maximum speed and economy but with minimum damage to the quality of the product. A job of this magnitude can be handled most effectively by splitting it up into smaller parts, which can then be attacked separately. For the first point of attack, it has been suggested that we get some real facts about the effects of drying on the properties of pure fibres; the effects of drying to include effects due to temperature, original moisture content, speed of heating the sample, and duration of drying; the fibres to include cotton, rayon, wool and silk; the properties to include strength, resilience, hygroscopicity, and ability to take dye.

"Later, the work would be expanded to study the effects of dyes, sizing materials, and other chemicals normally added to the fibres. The questions of the rate of circulation of the air and of heat interchange between the heating system, the air, and the fabric will require studies in a mill. At present, for the part of the program outlined definitely above, laboratory work will suffice. If you are operating your dryers at too low a temperature, you are losing money because you are not getting maximum output from them. If you are operating them at too high a temperature, you are losing money because the quality of your product is not so good as it might be. To make such that your dryers are being operated as economically as possible, you must have the information which this proposed research will produce. This work will cost about $5,000 a year. Will you or your company be one of fifty to contribute $100 each to get it started?"

For further details, stenographic report of conference discussion and subscription blank address C. H. Clark, Sec., U. S. Institute for Textile Research, Inc., 65 Franklin St., Boston, Mass.

The Retentivity of Water by Purified Cotton Cellulose

By HOMER A. HAMM* and W. A. PATRICK†

The adsorption of water vapor by cellulose was studied under conditions to ensure equilibrium. Under these conditions, it was found that cellulose exhibited no hysteresis.

This paper has been presented to the faculty of the Johns Hopkins University as the dissertation of the first-mentioned author in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Chemistry.

Introduction

THE retention of water plays an important rôle in the technology of organic fibrous materials, therefore it has long been the subject of many careful investigations. The present study was undertaken with a view of adding to our information in regard to the mechanism of the retention of water, rather than to supplement our knowledge of the actual amount of water retained under practical working conditions.

We have been guided largely in our approach to this problem by the belief that the presence of small amounts of permanent gases markedly influenced the amount of water retained by porous bodies. The theoretical import of this statement is not fully realized until the important rôle played by the phenomenon of hysteresis in all adsorption studies is remembered. A casual perusal of the adsorption literature is enough to disclose the fact that the occurrence of the phenomenon of hysteresis has served as a basis of dividing the whole consideration of the subject of adsorption into two distinct parts. Zsigmondy[1] was the first to explain hysteresis on the basis of a change in wetting conditions, and this view has served to associate the phenomenon of hysteresis with capillary condensation of the adsorbed vapor. In as much as hysteresis in adsorption measurements does not make its appearance until a considerable amount of vapor has been adsorbed, it is argued that the quantity of vapor adsorbed before the onset of hysteresis must necessarily have been taken up by some other means than by capillary condensation. (See Fig. 1.) The validity of this argument rests upon the reality of the phenomenon of hysteresis. If, for example, it can be shown that hysteresis has its origin in the failure of the experimenter sufficiently to control conditions so as to maintain true equilibrium between vapor and adsorbent, then it becomes necessary to reconsider the entire theoretical aspect of adsorption.

This latter viewpoint has been successfully proven with a large number of artificial inorganic adsorbents such as silica gel, alumina, etc.[2] In other

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words, it has been repeatedly demonstrated that in the case of these various inorganic gels adsorption occurred without any indication of hysteresis. No attempt at a general theory of adsorption has been made, but repeated suggestions of the inadequacy of the present theory of capillarity, or multi-layered adsorption, were always neglected due to the apparent reality of the hysteresis phenomenon in other systems. In the case of cotton, adsorption hysteresis has always been observed,[3, 4, 5, 6] with the result that there has been a general lack of application of the results obtained with inorganic gels. It is our belief that the behavior of cellulose as an adsorbent is not

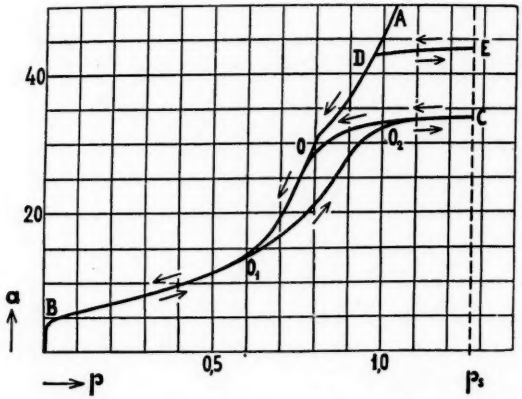

FIG. 1. Adsorption—desorption isotherms of SiO_2-gels. (Taken from H. Freundlich, *Capillarchemie, 2,* 555 (1932).

exceptional, but that it is exceedingly difficult to free it of permanent gases, especially oxygen.

It is therefore the purpose of this study to investigate the adsorption of water vapor by cellulose under conditions that ensure equilibrium.

Description of the Apparatus

The apparatus, as Fig. 2 shows, consists essentially of a sorption chamber, a manometer, a constant-temperature bath, an air-free water still, a MacLeod gauge and a mercury diffusion pump, along with the necessary accessories such as cut-offs, liquid-air traps, etc.

In the earlier experiments, there were three liquid air traps in the high vacuum part of the apparatus. It was necessary to remove these in order to avoid possible contamination of the samples during the measurements by the vapors which would re-evaporate upon the removal of liquid air from the traps. One trap was placed between the diffusion pump and the cut-off next to the high vacuum side.

The liquid-air traps, to facilitate cleaning, were equipped with a ground-glass joint sealed by mercury. They were tested to determine whether

there was any leakage of gas through the joint, and whether a liquid with a low vapor pressure which would wet the glass wouldn't seal better than mercury. The earlier set up with three traps of this type increased in pressure from a vacuum which no longer could be read by a MacLeod gauge to about 10^{-4} mm. of mercury in five days. This indicates that this type of trap does not permit appreciable leakage. Further, the use of mercury in glass barometers and cut-offs may be cited as a further indication that there is no leakage of gas past a mercury glass contact. To check the second point dibutyl phthalate was placed in the cup above the ground-glass joint, and with the system at a pressure of 1 mm. of mercury, about 1 ml. seeped through in five days.

The MacLeod gauge was calibrated by the Division of Weights and Measures of the National Bureau of Standards and was marked for reading

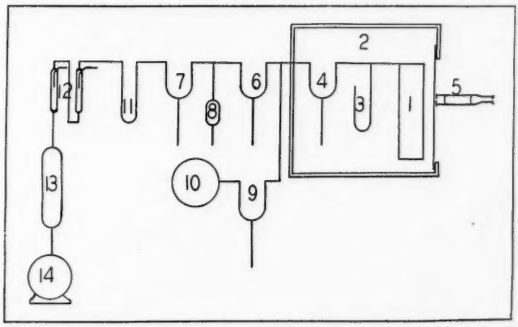

FIG. 2. Sketch of the apparatus finally used. 1, Sorption chamber; 2, Constant temperature bath; 3, Mercury manometer; 4, 6, 7, 9, Mercury cut-offs; 5, Micrometer microscope; 8, MacLeod gauge; 10, Air-free water still; 11, Liquid air trap; 12, Stimson two-stage diffusion pump; 13, Fore vacuum chamber; 14, "Hyvac" fore vacuum pump.

of 10^{-2}, 10^{-3} and 10^{-4} mm. of mercury pressure. Lower pressures could be estimated.

In the first experiments a still designed by Hibben[7] was used to remove permanent gases from water by freezing and subliming the water at liquid air temperatures. This still, however, had two disadvantages, namely: it required the use of liquid air on the high vacuum side of the apparatus and, secondly, it was too expensive to operate. A Taylor type[2] of still, which had been found satisfactory in the experiments on silica gel, was substituted.

A constant-temperature air bath made of a wooden box with necessary doors and windows in which the temperature could be maintained to within $\pm$ .04° C. was used. This bath enclosed the sorption cell, the manometer and the cut-off which separated this part of the system from the rest. The thermometers used in temperature readings were checked by the Heat Division of the Bureau, and were proven adequate for the needs of these

experiments. A constant-recording thermometer was kept within the bath to keep a check on the temperature at all times.

A mercury manometer of the U-type was used to measure the vapor pressures. This manometer had been filled in the same apparatus and under identical conditions for filling barometers at this Bureau. A micrometer vernier-screw arrangement was designed and built in the Bureau shops for reading the vapor pressures as shown by the manometer. This screw was graduated in hundredths of a millimeter.

In the earlier experiments the samples were placed in a series of glass bulbs attached to the apparatus. When, under certain conditions, equilibrium had been apparently reached as indicated by manometer readings, a bulb was sealed off. The weight of the sample and its water content were determined later. This arrangement had several disadvantages, namely: information could be gained about the sample for only those conditions at which the bulb had been sealed off; the manometer was the only check on the equilibrium, and there was danger of losing some of the glass when the bulb was opened.

The sorption chamber used by other investigators appeared to be free from these disadvantages. Therefore it was adopted for our final experiments. However, the sorption chamber was modified to fit our needs. Fig. 3 is a photograph of the sorption chamber used. As can be seen from the

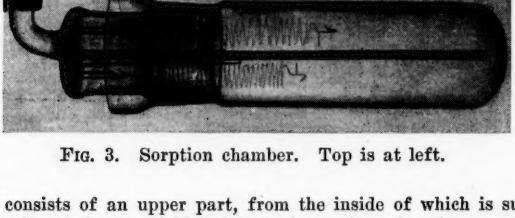

FIG. 3. Sorption chamber. Top is at left.

figure, it consists of an upper part, from the inside of which is suspended two quartz-fibre balances of McBain type,[8] a scale and a thermometer well, and a lower part ground to fit on the upper part. The cup on the lower part is to hold mercury for a seal over the ground-glass joint. The quartz-fibre balances are suspended from hooks on the upper part. The small pyrex glass hook on the bottom of the balance is for holding the sample. The pointer is for reading purposes. The pointer and the hook on the first balance were too heavy. This cut down the useful range of the balance. The heavier pointers and hooks were exchanged for some considerably lighter, and the useful range of the balance was increased up to 50% in some instances. The pointers were dipped in chloroplatinic acid and heated in the flame to give them a coated tip to help make them more visible.

A micrometer microscope was used to read the changes in length of the quartz-fibre balances. This micrometer microscope had a range of 50 mm. and could be read to .001 of a mm. It was checked by the Division of Weights and Measures of the National Bureau of Standards and found to give reproducible results to .01 mm. In order to increase its range it was mounted on a suitable base by means of which it could be raised and low-

ered. The scale inside the cell was obtained from a broken Beckmann thermometer and enclosed in a pyrex glass shell. The 10° C. lines were about 4.4 cm. apart, and their distances apart were determined within .01 mm. by the Division of Weights and Measures. It was planned to use this scale for a reference when the position of the micrometer microscope was changed.

The balances were calibrated by suspending weights of known value on the balance hooks and reading the corresponding elongations. The weights value had been determined by the Division of Weights and Measures to within .0001 gram. The calibration of the balances was made at 4 to 5 mm. pressure and at the same temperature at which the measurements were made.

Experimental Work

Twelve liters of double distilled water were treated with about 100 grams of NaOH and 175 grams of $KMnO_4$. This solution was heated for several days on a steam bath, and stored for three years. This solution was introduced into an all pyrex glass distillation apparatus and slowly distilled. The first portion of water coming over was discarded and the distillation stopped before all the water had distilled over. This water was redistilled over laboratory-distilled C. P. sulfuric acid, again discarding the first and last distillate. This double-distilled water was again distilled and then introduced into the air-free water still.

Unbleached cotton cheese cloth was selected as the adsorptive material for these experiments. To purify the cheese cloth without altering its physical characteristics, it was desized by an enzyme preparation (Rapidase). At the end of this treatment it gave a negative test for starch with iodine. The enzymes and the decomposition products were washed from the cloth by distilled water. Next, the cloth was rinsed several times in redistilled ethyl alcohol, and then extracted for 15 to 20 hours in a Soxhlet apparatus by alcohol, followed by a similar extraction with anhydrous ethyl ether. When this last extraction was completed, the cloth was air-dried and rinsed several times in alcohol to remove the greater portion of the ether. Then it was again extracted for 15 to 20 hours with alcohol. Following the alcohol extraction, it was exposed to the air, so most of the alcohol could evaporate, rinsed several times with special triple distilled water. Next, it was extracted with similar water for about two weeks. The water used for the extraction was replaced several times with fresh distilled water. The solvents in contact with the cotton during the last two extractions were kept near their boiling points.

The glass parts of the apparatus were cleaned by chromic-acid cleaning solution, washed out by tap water, followed by distilled water. In order to remove the last traces of grease, the parts were washed with redistilled ethyl alcohol followed by redistilled C. P. benzene. The apparatus was dried, and assembled, using city gas and oxygen in making all glass joint seals. All necessary blowing, in making the joints, was done through an ascarite absorbent cotton blowing tube. Mercury purified by Hullett's method was used in the MacLeod gauge; and acid, water washed and dried mercury in the cut-offs and the Stimson pump.

To prevent possible photochemical decomposition of the cellulose[9] the sorption chamber and the tube connecting it to the vacuum system were covered with friction tape, except a space through which readings were to be taken. This space was coated with an orange-colored transparent lacquer.

The purified cotton sample was suspended from one of the quartz spirals and the outer part of the sorption chamber was put in place. The entire system was tested for leaks, and, when it was determined that there were no leaks, the pure water was introduced into the air-free water still. The system was then sealed and pumped out to the lowest pressure obtainable with the hyvac pump. Now, the air-free water still was shut off by the cut-off in front of it from the other part of the system. This part of the system was pumped out by the diffusion pump so that it would hold a click vacuum overnight. The air from the water was removed by boiling and intermittently pumping out the air thus liberated. This process was continued for a sufficiently long period to assure complete removal of the air. It was necessary to close off the sorption chamber from the rest of the system during the removal of the gases from the water.

Next, the permanent gases were swept out of the sample and the system by running air-free water vapor into them and pumping this water out of the system along with the liberated air. It was necessary to repeat this operation a large number of times, and also keep the water free from air by running the air-free water still frequently. When the system was swept out a sufficient number of times and the pressure was reduced low enough by pumping, the system was tested to determine the rate of increase of pressure. This was checked three to four times, and it was found in each instance that the pressure increased from a click vacuum to 10^{-4} mm. of mercury in 14 days. It was felt that, under these conditions, satisfactory measurements could be made. Therefore, the system and sample were again swept out with air-free water and pumped out until the permanent gases were eliminated as far as possible.

Measurements were started by taking readings of the manometer, temperature, and the extension of the quartz-fibre balance. Next, a small amount of water vapor was admitted and readings taken when equilibrium was reached. This process was repeated several times and then the water was removed in several successive steps, readings being made at each step. The system and sample were again swept and pumped out and another series of observations made in like manner. This was repeated. The results of these observations of the adsorption—desorption of water by cotton in the absence of permanent gases are shown in Fig. 4.

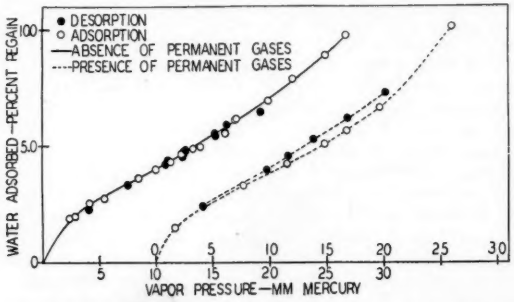

FIG. 4. Relation of the vapor pressure to the amount of water adsorbed. Results of three experiments.

Next, air was let into the system and permitted to remain for several days. The system and sample were then superficially pumped out until a click vacuum was obtained. The apparatus was allowed to stand for a day or so until the pressure had increased to about 10^{-4} mm. of mercury. Then measurements were made in a way similar to those just noted. The results of these observations of the adsorption—desorption of water vapors by cotton cellulose in the presence of permanent gases are also shown in Fig. 4.

All measurements were made at 29.05 ± .04° C. A temperature recorder was kept in the constant-temperature bath, and no readings were taken un less this recorder showed a constant temperature had been maintained for a long enough period to reach equilibrium. The temperature was read twice during the making of any given observation. All vapor pressure readings were made by the mercury manometer and could be duplicated within ± .03 mm. of mercury. Three readings were made of the extension of the spiral at each vapor pressure by the micrometer microscope. These readings check within .01 mm. which corresponds to a variation of less than one-half percent of the weight of the least amount of water adsorbed. The weight of the cotton sample used in these experiments was .0503 gram.

Discussion of Results

It is apparent that there are no marked breaks or discontinuities in the adsorption curve except in the very beginning of the measurements. In as much as there is general agreement as to the presence of a uni-molecular layer of adsorbed vapor, it is not surprising to observe a different trend in the course of the adsorption in the initial stages. While it is true that we have no definite information as to the surface exhibited by a unit weight of cellulose, there is little doubt that this surface is not sufficiently large to account for all the adsorbed water in the form of a uni-molecular layer. Since the total surface of silica gel is undoubtedly greater than that of cotton, and only 3% of the total water adsorbed by silica gel can be accounted for by a uni-molecular layer, it is probably safe to assume that the uni-molecular layer is only sufficient to account for the first few percent of the adsorbed water.

The possibility of the retention of the water by chemical combination or hydration of the cellulose must next be considered. If definite components or hydrates are formed their presence should be indicated by constancy of pressure over the range of the stable hydrate. Our measurements show no indication of such behavior.

If we still persist in the idea of chemical combination as an explanation of the retention of water, it therefore becomes necessary to postulate the existence of a whole series of hydrates. On the other hand, if other vapors such as benzene, carbon tetrachloride, alcohol, etc. should show a similar behavior as water, then the chemical combination explanation must be definitely abandoned. This latter state of affairs is exemplified by the inorganic gels, and there is little reason to doubt that cellulose would behave the same.

It is customary to assume the existence of a thick poly-molecular layer of adsorbed material to account for the retention of adsorbed vapor in excess of the uni-molecular layer. This view we hold to be erroneous on

the basis of the crucial experiments performed by Frazer, Patrick, and coworkers.[10, 11] Furthermore, a large mass of theoretical evidence has been accumulated against the idea of a poly-molecular adsorbed layer.

There still remains the possibility of explaining the magnitude of the adsorption based on the idea of capillary condensation. The application of surface energy considerations to explain the retention of water by porous bodies was first advanced by Friedel,[12] and later extended by Zsigmondy.[1] The essence of the idea is found in the thermodynamic fact that a liquid may be in equilibrium with its vapor at other than the normal vapor pressures provided the pressure on the liquid is different from the vapor pressure. The relation between the hydrostatic pressure on a liquid and its vapor pressure is given by the usual equation

$$vdp = VdP$$

where the left side represents the volume of the liquid and its change of hydrostatic pressure, while the right side refers to the gaseous volume and its change of pressure. If we assume that the vapor obeys the gas law, that the volume of the liquid is constant and that dp equal $2\sigma/r$ where $\sigma =$ surface tension and r is the radius of curvature of the liquid, then the integration of the above equation leads to the well-known Kelvin relationship:

$$\ln \frac{p}{po} = -\frac{2\sigma M}{RTdr}$$

If we calculate the vapor pressure of water in a tube of radius of 10^{-7} cm. at 29° C. we find it to be 10 to 11 mm. That is to say, in order to account for the retention of water on the basis of the ordinary capillary relationship it becomes necessary to assume radii of molecular dimensions or less. We are therefore faced with a clear reductio ad absurdum.

However a closer examination of the initial postulates made in the integration of our thermodynamic equation, reveals the distinct possibility of extending the range of the capillary concept. It is not sound to assume that the density of a liquid in very small tubes is that of the normal liquid. Furthermore, it is questionable whether the surface tension of a liquid is independent of the radius as assumed. Along such lines as these do we believe it possible to present a complete mechanism for the retention of vapors by porous bodies such as cellulose and the like.

Work is now in progress to modify the Kelvin capillary relationship so as to extend its application and to make it more accurately reflect experimental measurements. It is our belief that this idea, together with an initial mono-molecular adsorbed layer, will faithfully reflect the complete course of the adsorption of vapors by porous bodies. It is perhaps unnecessary to say that these ideas are limited to the adsorption of vapors or gases in the absence of specific chemical or adsorption effects. In other words, it is clearly recognized that there are many types of adsorption that do not come under the scope of these ideas.

Conclusions

(1) Measurements of the adsorption and desorption of water vapor by cellulose are described under conditions that have completely eliminated the phenomenon of hysteresis.

(2) The theoretical aspects of these new results were briefly discussed and provisional suggestions made for the extension of the problem.

The authors wish to express their appreciation to W. E. Emley, Chief of the Organic and Fibrous Materials Division of the National Bureau of Standards, for his interest and co-operation, to S. F. Acree for helpful suggestions, to E. O. Sperling for suggestions on the design of the apparatus, and to the National Bureau of Standards for opening its many facilities to them.

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"Inside the United States I can find no evidence that technological unemployment is a serious, long-range factor in our unemployment situation. Your own organization is avowedly trying to cheapen cost, and improve products through research, and if you succeed it not only helps you but it helps equally the public, since it enables it to wear more and better clothes for less money. True, you may employ less labor but the money that you have saved the buying public is ready to employ that labor to satisfy its new wants which are limitless, and my figures seem to show that it does it, at least within the United States." From Address of Dr. Robert A. Millikan to U. S. Institute, Nov. 14, 1935.

The Reducing Power and Average Molecular Chain-Length of Starch and Its Hydrolysis Products, and the Constitution of Their Aqueous Pastes.*

W. A. Richardson, R. S. Higginbotham, and F. D. Farrow.
J. T. I., May, 1936, P. T131–T157.

Introduction and Summary

"It is now generally accepted that the starch molecule consists of glucose units linked together in a continuous but not endless chain, the linkages being all of the same type and identical with those found in the disaccharide maltose. In such a chain the units situated at the ends differ, by virtue of their position, from one another and from the remainder, and a determination of the proportion of either terminal unit enables the number of units in the chain to be calculated. Haworth and his collaborators,[1, 2, 3] who first established the constitution of starch, have determined the proportion of the non-reducing end-unit in fully methylated starch and conclude that the number of glucose units in a starch chain-molecule is in the neighborhood of thirty.

"On Haworth's theory, if the chain-molecules have a finite length, starch should possess a reducing power which would be less the greater the length of the molecular chain. Most workers have, however, failed to find evidence of reducing properties in starch. Haworth,[4] for example, states that his materials do not reduce Fehling's solution and although iodine numbers from 0.4 to 0.7 are recorded, these are apparently regarded as negligibly small.

"In this paper it is shown that unmodified starch does possess reducing properties. A method is described for the determination of the reducing terminal unit in starch, modified starches and sugars, and the relation between the copper-reducing power, the viscosity and the solubility in water of different starches and the products obtained from them by treatment with acids is discussed.

Measurement of Reducing Power

"The method employed in this work is a modification of that of Fargher and Probert[5] in which the starch is heated with an alkaline copper solution; the cuprous oxide produced is separated, dissolved in iron alum

* This is merely the introduction and summary of the report of the authors' research at Shirley Institute of the British Cotton Industry Research Association on this subject. The complete report as published in the May, 1936, number of the *Journal of the Textile Institute* not only covers experimental methods and results together with discussion of the latter, but also includes very complete tabulated and diagrammatic data, a detailed description of the method employed in the determination of the reducing power of starch, modified starches and sugars, and some 25 references. It is a valuable addition to the basic information on starches, and, indirectly, on their application in sizing.—Editor.

solution, and determined by titration with permanganate. It is shown that in Fargher and Probert's method the whole of the reduced copper is not recovered, probably on account of the slight solubility of cuprous oxide in the alkaline reagent, so that low values for the copper number are obtained. When the solubility of the cuprous oxide exceeds the total amount produced in the reaction none is precipitated, and the copper number is apparently zero. In the method now adopted saturation of the solution is ensured by the addition of a known quantity of glucose, slightly in excess of the amount required, into the reaction mixture along with the starch. The excess is allowed for by subtracting the amount of cuprous oxide found in a separate blank experiment with glucose alone.

"To avoid difficulties in the filtration of solutions of unmodified starch the whole determination, including reduction of copper, separation and washing of the cuprous oxide, solution of the latter in iron alum, and the final titration, are carried out in a centrifuge tube. It is frequently impossible to free the cuprous oxide from starch in this way, but when ceric sulphate is employed in the titration instead of the more usual potassium permanganate, with *o*-phenanthroline as indicator, no difficulty is experienced in obtaining a sharp and stable end point. The method is equally applicable to unmodified starches, modified starches and reducing sugars.

"The reducing power, R_{Cu}, of unmodified starch is defined as the number of milligrams of copper reduced by one gram. For modified starches and sugars the unit of weight is not the gram, but the weight that is equivalent to one gram of starch. For example, I.III gram of glucose, $C_6H_{12}O_6$, and I.0556 gram of anhydrous maltose, $C_{12}H_{22}O_{11}$, are equivalent to one gram of $C_6H_{10}O_5$, and these weights are respectively the basis to which their reducing powers are referred. For any one material the reducing power is independent of the amount employed in the determination.

Unmodified Starches

"Unmodified starches are found to have reducing powers ranging from 2.8 to 8.9. Of the starches examined the sago samples have higher reducing powers than those of maize or farina (potato starch), but it is not possible to distinguish between the different varieties by their reducing powers alone. There is no correlation between reducing power and ash or nitrogen content, and the evidence suggests that the reducing properties are associated with the starch itself and are not due to impurities.

Acid-modified Starches

"It is well known that when starch pastes are treated with acid the resulting products have considerable reducing properties. Fargher and Probert[5] have examined the relation between the copper number and the acid concentration, the time of heating and the temperature of pastes heated with sulphuric and hydrochloric acids. They found that except for a short period at the commencement of the reaction, the copper number increased in a linear manner with the time of heating. In the present experiments the hydrolysis has usually been carried out at a higher temperature and a lower acid concentration than in those of Fargher and Probert, and more concentrated solutions of starch have been employed. In the main the results confirm the conclusions previously reached. No evidence has, how-

ever, been obtained for the existence of the initial lag period, and, starting from the value given by the unmodified starch, the reducing power is found to increase at a constant rate from the beginning of the reaction.

"When the hydrolysis is allowed to proceed sufficiently far, the rate of increase of reducing power diminishes and ultimately a reducing power is attained only slightly lower than that of pure glucose. On further heating, the reducing power diminishes slightly. Under similar conditions the reducing power of pure glucose has also been found to diminish.

Viscosity

"In general the viscosities of unmodified pastes, measured by the method described in a previous Memoir,[6] do not bear any simple relation to the reducing power; it has, however, been observed that among sago pastes, the viscosities of which are much lower than those of maize or farina, the lower the viscosity, the higher in general is the reducing power.

"The viscosities of 2.5% solutions of acid-modified farinas in 1% sodium hydroxide solution have also been determined, and it is found that the points connecting viscosity and reducing power lie on a smooth curve. The viscosity falls very rapidly with increase of reducing power in the early stages of acid attack, but no examples have occurred in which the viscosity of an acid-treated starch paste has decreased without a corresponding increase in reducing power.

Fractionation of Starch

"Fractions differing in reducing power may be separated from pastes of modified or unmodified starch by storage at a low temperature or by freezing, followed by extraction with water. The reducing power of the dissolved portion so obtained is higher than the average of the whole, and that of the precipitate is lower. The amount of the soluble fraction, its reducing power, and the reducing power of the precipitate increase continuously as the reducing power of the parent paste increases.

"Highly modified pastes separate into two phases on standing even at room temperature, and the precipitate occupies a relatively small proportion of the total volume. With less highly modified materials the precipitate is more bulkly, and if the degree of modification is still lower the precipitate may appear to occupy the whole volume, so that there is no aqueous layer. The paste in this condition is a soft gel and the less modified the starch the stiffer and more compact is the gel obtained.

The Average Length of the Starch Chain-Molecules

"The reducing power as measured by the method described in this paper is considered to be an accurate measure of the reducing groups in a sample of starch. If the assumption is made that all the chain-molecules terminate in reducing groups it is possible to calculate the average length of the chains from the ratio between the reducing power of the sample and that of a substance of known chain-length, such as maltose, which contains two glucose units in its molecule. The reducing power of maltose is 2055, and those of the unmodified starches are from 2.8 to 8.9. These figures therefore cor-

respond respectively to chain-lengths of $2 \times 2055/2.8 = 1470$ and $2 \times 2055/8.9 = 460$ glucose units. Acid modified starches give values intermediate between those of starch and maltose.

Acid Hydrolysis

"When an unmodified paste is treated with acid, hydrolysis of the glucoside linkages takes place, and the molecular chains are shortened. The results suggest that the attack is directed at random points along the molecular chains so that in any paste of modified starch there is a wide distribution of chain-lengths. As hydrolysis proceeds an increasing number of short chains is produced and since products with short chains are more soluble in water than those with longer chains the soluble fraction obtained after freezing and extraction increases and the precipitated fraction decreases. The average chain-length of both fractions also decreases.

Soluble Starch

"In the early stages of hydrolysis a small increase in reducing power corresponds to a large decrease in average chain-length. It is already known from the work of Staudinger[7] that the viscosity of a solution of chain-molecules is very closely related to their average length and on this account a rapid initial diminution of viscosity would be anticipated. This rapid diminution in the viscosity of starch pastes has long been known and has hitherto been attributed to the formation of "soluble starch" by a process of disaggregation or liquefaction preceding and differing in kind from hydrolysis proper. From the results now presented it appears that such an assumption is not necessary in order to explain the phenomenon, and 'soluble starch' must be regarded as a degradation product of starch differing from unmodified starch and from other degradation products only in the average length, and distribution of length, of the component chain-molecules."

References

1. Baird, Haworth and Hirst. *J. Chem. Soc.*, 1935, 1201.
2. Haworth, Hirst and Woolgar. *Ibid.*, 1935, 177.
3. Hirst, Plant and Wilkinson. *Ibid.*, 1932, 2375.
4. Haworth and Percival. *Ibid.*, 1932, 2277.
5. Fargher and Probert. *Shirley Inst. Mem.*, 1927, *6*, 89, or *J. T. I.*, 1927, *18*, T559.
6. Richardson and Waite. *Shirley Inst. Mem.*, 1933, *12*, 101, or *J. T. I.*, 1933, *24*, T383.
7. Staudinger. "Die hochmolekularen organischen Verbindunger, Kautschuk and Cellulose". Berlin, 1932.

Abstracts

This section is compiled under the direction of the Committee on Abstracts and Bibliography: Prof. E. R. Schwarz, Chairman, M. W. Weiss, Dr. Irving J. Saxl and C. H. Clark.

I. Fibres (Synthetic and Natural) and Fibre Analysis

Carboxylic Acid Groups: Concentration and Ionizing Tendency of—in Cellulose and Other Natural Products. S. M. Neale. *Nature*, Apr. 13, 1935, P. 583.

Cellulose which has been subjected to oxidation with an alkaline oxidant is presumed to contain carboxylic acid groups, but does not show acid characteristics of the order usually associated with this group. The reason for this is that, while the carboxylic acid groups are ionized within the cellulose phase, the hydrions are unable to escape into external water, since the anions form part of the cellulose lattice. (From *Cotton Literature*, Feb. 1936, P. 55.) (C)

Casein Wool. Werner von Bergen. *Rayon & Mell.*, Jan. 1936, P. 75; *Am. Dye. Rptr.*, Mar. 23, 1936, P. 146.

Describes physical and chemical tests and gives longitudinal and cross-sectional microphotographs. States that with its present properties the fibre may take a place in Italy similar to Vistra in Germany, but is in no way a fibre which can replace wool on the world market. There is no doubt that the casein fibre can be materially advanced as the different rayons were improved tremendously since their introduction into the world market 30 years ago. (C)

Cellulose Decomposition Through Fungal Activity. F. Rossi and G. Rozzi. *Boll. 1st agr., Pisa*, 1934, V. 10, P. 112, 271–5 (through *Rev. Appl. Mycol.*, 1935, V. 14, P. 584); *J. T. I.*, Nov. 1935, P. A597. (C)

Celllulose: Electron Diffraction. H. Mark, H. Motz and J. J. Trillat. *Naturwiss.*, 1935, V. 23, P. 319 (through *Physikal. Ber.*, 1935, V. 16, P. 1620); *J. T. I.*, Nov. 1935, P. A597. (C)

Cotton Hair: Structure. E. Weiss. *Textilber.*, 1935, V. 16, P. 659–60.

In studies of mercerized half-bleached cotton hairs it has been found that the inner membrane surrounding the lumen does not dissolve so readily as the cellulose layer in cuprammonium solution. In some cases, as the hair swells and shortens in the solution the inner membrane and its contents project from the end of the hair and even in this state show marked resistance to solution in the cuprammonium solution. The difference between the behavior of this inner membrane and the cellulose wall decreases with increasing purity of the cotton but even with well-purified cotton the

membrane surrounding the lumen is coloured a deeper blue and dissolves more slowly in cuprammonium solution. It is suggested that this membrane is a conversion product of cellulose and that the difference between its behavior and that of cellulose is accentuated by the infiltration of foreign substances such as proteins and waxes. (From *J. T. I.*, Nov. 1935, P. A551.) (C)

SEPARATION OF CELLULOSE PARTICLES IN MEMBRANES OF COTTON FIBRES BY TREATMENT WITH HYDROCHLORIC ACID. W. K. Farr and S. H. Eckerson. *Contrib. Boyce Thompson Inst.*, 1934, V. 6, P. 309–13.

Treatment of mature fibres with hydrochloric acid of specific gravity 1.19 for periods up to five days removed non-cellulose constituents, without affecting the essential characteristics of the cellulose. (From *Paper Trade J.*, Feb. 13, 1936, P. 36.) (C)

SILK COCOONS: INNER AND OUTER LAYERS OF. R. Tsunokaye. *J. Soc. Dyers Col.*, Nov. 1935, P. 384–7.

Treats of fibre properties which affect the visual size of raw silk in the seriplane test. (C)

TEXTILE FIBRE: NEW. *Tex. Merc. & Argus*, Dec. 20, 1935, P. 534.

It is reported that a process developed by Japanese research workers will permit of a textile fibre being produced from "sugamo," a species of seaweed abounding in Japanese waters. . . . The fibre is said to have the feel and appearance of intermediate quality Egyptian cotton. It retains heat and repels water. Denier ranges are from 30 to 60, tensile strength, it is claimed, is greater than raw silk, and it can be made into yarns of 80 to 100 counts in cotton equivalents. (From *Cotton Literature*, Feb. 1936, P. 45.) (C)

TEXTILE FIBRES: IMPORTANCE OF STRUCTURE FOR FINISHING PROCESSES. Haller. *Textilber.*, 1935, V. 16, P. 110–11, 185–7.

A review of the structure of cotton, wool, silk and bast fibres, the effect of various treatments on structure, the importance of fibre structure in mercerizing, bleaching, dyeing and finishing operations, and the influence of structure on strength, resistance to creasing and other properties. (From *J. T. I.*, July 1935, P. A361.) (C)

TEXTILE RAW MATERIALS OF GERMAN PRODUCTION. H. Deichmann. *Deut. Wollen-Gewerbe*, 1934, V. 66, P. 928–9.

A short survey. A complete substitution of wool is not possible in Germany. (From *C. A.*, 1935, V. 29, Col. 8339.) (W)

VISCOSE: COAGULATION MECHANISM. H. Sobue. *J. Soc. Chem. Ind., Japan*, 1935, V. 38, P. 474–7B.

Diffusion data for caustic soda and sulphuric acid and strength and extensibility data for viscose threads at different times after spinning are given and the mechanism of the coagulation of viscose in the spinning process is discussed. It is concluded that the viscose is first decomposed and the cellulose regenerated in the surface layer in contact with the acid bath. Alkali then diffuses into the bath from the viscose thread and coagulation proceeds from the surface inwards owing to the decrease in alkali concentration. The viscose thread drawn out of the coagulation bath consists of

an alkaline inner part and an acidic surface skin and later, as a result of diffusion, mutual neutralization of the acid and alkali occurs. (From *J. T. I.*, Dec. 1935, P. A610.) (C)

VISCOSE: RIPENING; TEMPERATURE EFFECT. P. N. Voskressenski. *J. Prikl. Khim.*, 1934, V. 7, P. 967–71 (through *Chim. et Ind.*, 1935, V. 34, P. 655); *J. T. I.*, Dec. 1935, P. A611. (C)

VISCOSE SOLUTIONS: RIPENESS TEST. J. D'Ans and A. Jäger. *Cellulosechemie*, 1935, V. 16, P. 22–36; *J. T. I.*, Sept. 1935, P. A446. (C)

WOOL-SCOURING MACHINE: COUNTERCURRENT OPERATION OF A. S. M. Gornostaev and M. Munitz. *Sherstyanoe Delo*, 1935, No. 2, P. 61.

The four tanks of the machine are so connected by tubes that the small discharge of the liquid from one of the tanks is constantly replaced by addn. of an equal amt. of warm water in the tank located at the opposite end. The temps. maintained in the barges are up to 47°, 52°, 50° and 40°. Na_2CO_3 is added in the amt. of 2.5% on the wt. of the wool in the first three tanks. (From *C. A.*, 1935, V. 29, Col. 8345.) (W)

WOOL: EFFECT OF HEAT ON. M. C. Marsh. *J. T. I.*, June, 1935, P. T187–96.

The object in studying the effect of heat on wool was twofold. Firstly it was desirable to gain some information about possible damage during drying after scouring, tentering or any other process in which it is exposed to high temperatures. Secondly, the advantages offered by wool as an electrical insulator made it necessary to investigate the changes which would be brought about by prolonged periods at temperatures such as obtain in fully loaded electrical plants. It was therefore decided to test the wool in the form of yarn and to confine the work primarily to the strength and extension at break, and changes in the weight and colour.

Conclusions: (1) Increasing temperature causes a decrease in the strength and extension and weight of both wool and cotton. Above 100° C., there is generally a change in colour. (2) The dew-point of the air during the heating period (*i.e.*, the humidity) has little effect on strength and extension. High dew-points prevent loss of water to some extent at lower temperatures but cause a decrease in the subsequent hygroscopic capacity. (3) If there is little damage to the yarns on heating for a few hours, little more will occur on prolonged heating. If the temperature is high enough to cause damage, this will go on progressively throughout the heating period. (4) At high temperatures, wool is less damaged than cotton and the rate of deterioration is less. (C)

II. YARNS AND FABRICS

AFTER-TREATMENT OF RAYON CRÊPE PRINTS—DRYING. A. P. Kirk. *Tex. Mfr.*, Jan. 1936, P. 34.

Requirements in drying rayon crêpes including acetate silk dyed and printed in various styles. (C)

ARTIFICIAL VELVET. *Rayon & Mell.*, Jan. 1936, P. 70.

A rayon-latex product with extensive decorative possibilities. (C)

CARBONIZING PROBLEMS. F. C. Pratt. *Tex. Mfr.*, Feb. 1936, P. 72.

Essentials in carbonizing of wool, and precautions in piece-goods carbonizing. The open-width carbonizing plant is described. (C)

CELLULOSE ACETATE RAYON SIZES: PROPERTIES AND APPLICATION. A. Eichler. *Textilber.*, 1935, V. 16, P. 658–9; *J. T. I.*, Nov. 1935, P. A562. (C)

CELLULOSIC MATERIALS: SORPTION OF WATER VAPOR ON. E. Filby and O. Maas. *Canadian J. Rsch.*, July, 1935, P. 1–10; *J. T. I.*, Nov. 1935, P. A579.

A direct method used for measuring the adsorption of water vapor on cellulosic materials and in which a number of improvements have been made is described. It is ensured that no vapors other than water are present no matter how long a time is required for the establishment of equilibrium. The adsorption and desorption isotherms of standard cellulose, spruce wood, surgical cotton, Kodak rag cellulose and bleached sulphite have been measured, and the data which indicate the time required for the establishment of true equilibrium have been given. The data of Urquhart and Williams for standard cellulose determined by an indirect method in 1926 have been shown to be correct. (From *Cotton Literature*, Feb. 1936, P. 53.) (C)

CHEMICAL TREATMENT OF WOOL IN PREPARATION FOR CARDING. *Rev. Tex.*, 1935, P. 481; *Rayon & Mell.*, Feb. 1936, P. 86. (C)

CLOTH: EFFECT OF NUMBER OF WARP AND FILLING YARNS PER INCH AND SOME OTHER ELEMENTS OF CONSTRUCTION ON THE PROPERTIES OF. H. F. Schiefer, D. H. Taft and J. W. Porter. *B. S. J. Rsch.*, Feb. 1935, P. 139–47.

Series of plain-weave and 3/3 basket-weave cloths were woven from 80s (67.2 typp) cotton yarns, varying the number of warp and filling yarns per inch from 80 to 120, and the twist multiplier of the filling yarns from 2.48 to 5.64. The cloths were tested for weight, thickness, air permeability, elongation at rupture, breaking strength, fabric assistance, and tear resistance. The effects of the variations in construction on these properties are reported and discussed. Experimental data are given on the effect of abrasion of the yarns during weaving on the breaking strength and fabric assistance of cloths woven from 2/140 (2/117.6 typp) mercerized-cotton yarns in which the number of warp yarns per inch was kept constant at 114 and the number of filling yarns per inch varied from 30 to 120. (C)

COLOR IN DESIGN. Faber Birren. *Tex. Wld.*, Feb. 1936, P. 83.

The author gives a few simple rules which ensure harmony. (C)

COMBATING MILDEW. *Tex. Recdr.*, Jan. 15, 1936, P. 24.

Mentions certain preventives that are unsuitable for textile use, and two new agents that are effective and suitable. One of the latter is a non-toxic higher tertiary alkylphenol sold as "Abracide," and the other a salicylanilide which appears under the names of "Shirlan Powder" and "Shirlan Paste." (C)

COTTON MACHINERY: RECENT DEVELOPMENTS IN. Frank Nasmith and Walter English. *Interntl. Cotton Bull.*, July, 1935, P. 681–703.

Of especial interest in this review, which was presented at the International Cotton Congress, Rome–Milan, May, 1935, are the descriptions of the "Shirley analyzer" for testing samples of raw cotton for the quantity of trash they contain; a roving tester developed by Rudolf Knote of Leipzig, Ger., which determines the amount of twist to be put into a roving, and also inspects roving irregularity; the "Distanceur Litty," also made by Knote, for testing the correctness of drawing roll settings for any particular cotton; the "Static Anti-Stripper" for cards, an invention of Spanish origin which allows cards to operate for 48 hours on American or Indian cottons with only one or two strippings. The device, which utilizes the principle of electrostatic induction, "is placed a short distance from the wire of the card clothing, and it is stated that the electrostatic action compels the fibres to remain on the surface, with the result that the maximum carding action of the fibrous mass is obtained, at the same time preventing accumulation between the points of the card wire." (C)

COVERED ELASTIC THREAD. L. Rowland. *Hosiery Tr. J.*, 1935, V. 42, No. 503, P. 48–50.

Abstract of lecture before Leicester Textile Society, Oct. 4, 1935, describing the properties of lactron thread, its manufacture from latex and the method of covering it with cotton to produce the finished cord. Experiments have proved that perspiration reduces the useful life of rubber thread by about one-third, but that lactron thread is in this respect superior to square cut. The perspiration of a heavy meat eater has a more damaging effect on rubber thread than that of a vegetarian. (From *J. T. I.*, Jan. 1936, P. A9.) (C)

DERMATITIS FROM DYED HAIR, FURS AND FABRICS. J. T. Ingram. *The Lancet*, 1935, P. 239–43; *J. Soc. Dyers Col.*, Jan. 1936, P. 21. (C)

DERMATITIS FROM KNIT GOODS CONTAINING SULPHITES. Important Privy Council Decision. *J. Soc. Dyers Col.*, Jan. 1936, P. 21. (C)

DESIGN MACHINE IS READY. *Tex. Bull.*, Jan. 23, 1936, P. 19.

Harry A. Silverman and Morris Zalma, of the Apex Textile Designers, 40 Worth Street, New York, announced completion of an invention to be known as the Designometer. Its purpose is to offer converters and others in industries outside the textile division a flexible and unlimited selection of patterns beyond anything so far conceived. The process of design selectivity is through the manipulation of an electrical machine which manipulates any pattern in such a way as to develop it into as many as 48,000 distinct variations. (C)

RUBBER LATEX: NEW PROGRESS IN THE IMPREGNATION OF TEXTILES BY. THE "FILASTIC" INDUSTRY. J. E. Ch. Bongrand. *14me Congr. chim. ind.* Paris, Oct. 1934, 6 pp.; cf. *C. A.*, 1934, V. 28, Col. 365; 1935, Vol. 29, Col. 6067.

An outline of the developments and improvements in "Filastic" since 1932. Difficulties encountered in the impregnation of textile fibres with

latex have been overcome by pH control, which has resulted in regulating the degree of penetration. By aging, the latex is fixed inside the fibre. The properties and possible applications of "Filastic" are outlined. (W)

SHRINKAGE OF COTTON. B. Mae Yoder and M. L. Willard. *Tex. Col.*, Nov. 1935, P. 772.

Conclusions: (1) Shrinkage occurs in the diameters of the fibres, and since the threads are made up of fibres the threads also must shrink. The interspaces contracted to a greater extent than the fibres. (2) Shrinkage occurs in both the length and diameter of the fibre but the percentage shrinkage is greatest in the latter case. (3) Shrinkage takes place in both the warp and filling directions but the percentage shrinkage generally is greatest in the warp direction. (C)

SIZING OF RAYON. A. Foulon. *Spinner u. Weber*, 1934, V. 52, No. 26, P. 10–12.

Linseed oil sizes give poor results as they damage the fibre because of oxidation. Other disadvantages are difficulty of desizing, inflammability of solvent, unsuitability for sizing on warp beam, high price, etc. The new universal size Silkovan is suitable for warp-beam and strand sizing. It is light brown, easily sol. in warm water forming a pretty stable soln., and does not affect the natural luster of the rayon. Concns. used are 3–5 kg. per 100 for viscose, etc., and 9–12 kg. per 100 for acetate rayon. The best sizing temp. is 60° for warp-beam sizing and 40° for strand sizing. The drying temp. is 40°. The desizing is carried out with water at 40°. (From *C. A.*, 1935, V. 29, Col. 8345.) (W)

SIZING OF RAYON. R. Hunlich. *Künstseide*, 1935, V. 17, P. 211–13.

Description and discussion of procedures for ball-warp sizing and full-width sizing of fine-filament rayons. (From *C. A.*, 1935, V. 29, Col. 7665.) (W)

SYNTHETIC (YARN) SIZING WHICH WEAKENS. Anon. *Am. W. & C. Rptr.*, Dec. 12, 1935, P. 17. (C)

TESTING OF THE UNIFORMITY OF (TEXTILE) FABRICS. W. Frotscher. *Deut. Wollen-Gewerbe* 66, *Erfahr. u. Forsch.* 1, 1934, P. 35–6, 37–8; *Deut. Wollen-Gewerbe* 67, *Erfahr. u. Forsch.* 1, 1935, P. 41–2.

A review of several exptl. methods. (From *C. A.*, 1935, V. 29, Col. 8339.) (W)

III. CHEMICAL AND OTHER PROCESSING (NOT OTHERWISE CLASSIFIED)

LIGHT FASTNESS OF DYES ON VEGETABLE FIBRES. C. M. Whittaker. *Silk and Rayon*, 1935, V. 9, P. 591; cf. *C. A.*, 1935, V. 29, Col. 7661; 1936, V. 30, Col. 289. (W)

LIME SOAP PROBLEM IN TEXTILE FINISHING. A. Foulon. *Allgem. Oel- u. Fett-Ztg.*, 1935, V. 32, P. 363–5.

The use of Calgon (Na metaphosphate) is recommended to eliminate the formation of insol. Ca salts when hard waters are used for textile operations. (From *C. A.*, 1936, V. 30, P. 293.) (W)

LUSTER EFFECTS ON COTTON. *Z. für die ges. Textilind.* (translation by *Dyer & Textile Printer*); *Tex. Bull.*, Jan. 23, 1936, P. 8.

The value of cotton fabrics and threads is greatly enhanced when they are subjected to the action of inorganic esters of monohydric alcohols in the presence of alkalis. Fine effects are also achieved on cotton by treating with nitrating acid cooled to 0° C. or less. Cotton goods assume a very attractive luster when they are coated or impregnated with the solution of a cellulose derivative which is soluble in volatile solvents and fast to shrinking agents, and thereafter are treated with a medium that causes fabric to shrink. It is, of course, possible to produce highly lustrous cotton threads by covering them with a rayon solution. Cotton fabrics can readily be given a velvet-like finish when they are prepared for napping by spreading alkali soap solutions with an admixture of sodium perborate on the right side of the fabric or the side to be napped. (C)

MOTHPROOFING AGENTS FOR TEXTILE GOODS. Stötter. *Spinner u. Weber*, 1935, V. 53, No. 36, P. 11–14.

A discussion of several patents on mothproofing materials and of the use of a no. of dyes for the manuf. of mothproof goods. (From *C. A.*, 1936, V. 30, P. 293.) (W)

OXYCELLULOSE IN COTTON FABRICS BLEACHED FOR DYEING. A. J. Hall. *Tex. Wkly.*, 1935, P. 220; *Rayon & Mell.*, Feb. 1936, P. 88.

The author presents two methods by which the dye-resist properties of patches of oxycellulose in cotton fabrics can be obviated. (C)

PEROXIDE BLEACH BATHS AND SOME FACTORS INFLUENCING THEIR STABILITY, D. J. Campbell. *Am. Dye. Rptr.*, Feb. 10, 1936, P. 67. (C)

POLYSACCHARIDES. XXII. CONSTITUTION AND MOLECULAR STRUCTURE OF *a*-AMYLODEXTRIN. W. N. Haworth, E. L. Hirst and A. C. Waine. *J. Chem. Soc.*, 1935, P. 1299–1303; *J. Soc. Dyers Col.*, Dec. 1935, P. 424. (C)

PRINTING OF GOLD BRONZES ON WOOL TEXTILES. A. Molnar. *Monatschr. Textil-Ind.*, 1935, V. 50, P. 246; *C. A.*, 1936, V. 30, Col. 290. (W)

REMOVAL OF SIZES AND FINISHES UNTIL THE IODINE REACTION COMPLETELY DISAPPEARS; OPTIMUM TEMPERATURE BY USING DIASTAFOR. H. Fritsch. *Mell. Textilber.*, 1935, P. 657; *Rayon & Mell.*, Feb. 1936, P. 88. (C)

RICE STARCH: PROPERTIES. T. Tadokoro. *J. Faculty Sci. Hokkaido Impl. Univ.*, 1934, (3) V. 2, P. 59–79 (through *C. A.*, 1935, V. 29, Col. 2013); *J. T. I.*, Nov. 1935, P. A597. (C)

SIZES AND FINISHES: BEHAVIOR OF STARCH AND DEXTRIN SOLUTIONS TOWARDS OTHER USUAL ADDITIONS IN. F. Dittmar and H. Kober. *Mell. Textilber.*, 1935, V. 16, P. 734–7.

Solutions of the same kinds of textile starches exhibit considerable differences in behavior as regards development of turbidity. Thus, additions of salts or capillary active substances in moderate concentration produce

only a slight increase in turbidity, whilst at low concentrations there is a considerable alteration in the swelling of the flocks and more or less pronounced turbidity or flocculation occurs after a short time. The clarity of the solutions does not govern the clarity of the films. The behavior of starch solutions towards capillary active substances and electrolytes is used, in conjunction with other tests, in evaluating textile starches. The differences in behavior of the individual starches are due to differences in internal structure. Thus, solutions which tend to flocculate readily have a non-uniform composition, whilst those which remain clear are homogeneous and are only very slightly hydrolyzed. (From *J. Soc. Dyers Col.*, Dec. 1935, P. 424.) (C)

SIZING OF RAYON AND CELLULAR WOOL. Fritz Ohl. *Spinner u. Weber*, 1935, V. 53, No. 40, P. 7–10; *C. A.*, 1936, V. 30, Col. 292. (W)

SOAP-LIKE BASES. E. D. Pierce. *Rayon & Mell.*, Jan. 1936, P. 71. (C)

STARCH DEXTRINS: CONSTITUTION AND CHAIN LENGTH. W. N. Haworth, E. L. Hirst, and M. M. T. Plant. *J. Chem. Soc.*, 1935, P. 1214–7; *J. T. I.*, Nov. 1935, P. A595. (C)

STARCH AND GELATIN: HYDRATION IN ALCOHOL-WATER MIXTURES. M. W. Tschapek. *Kolloid Z.*, 1935 V. 72, P. 46–50; *J. T. I.*, Nov. 1935, P. A598. (C)

WASHING PROCESS: REACTIONS BETWEEN (TEXTILE) FIBRES AND WASHING AGENTS DURING THE. W. Seck. *Fettchem. Umschau*, 1935, V. 42, P. 124–7.

The use of X-rays in studying the fine structure of textile materials and detergents is briefly discussed. Since most washing agents are capable of forming gels, it is suggested that the formation of a gel-like layer of washing agent on the surface of the fibre may be of great importance in the washing process. (From *C. A.*, 1935, V. 29, Col. 8341.) (W)

WETTING-OUT AGENTS: LABORATORY EVALUATION OF. T. Kennedy. *Dyer*, 1935, V. 74, P. 389–90.

Two variations are suggested in Herbig's method for testing wetting-out agents described by Evans (see *J. T. I.*, 1935, P. A505). Standard tests for sinking, capillarity, stability to hard water, and fatty matter content are also described. (From *J. T. I.*, Dec. 1935, P. A640.) (C)

WOOL AND WOOLEN GOODS: EXTREMELY WHITE. M. Loescher. *Deut. Wollen-Gewerbe*, 1934, V. 66, P. 713–14.

Wool or woolen goods which has been rendered white by means of S tends to assume a yellowish tinge, while superoxide makes the goods look limy and reddish. The white appearance can be improved by adding a dye to the rinsing, soap or bisulfite bath. Detailed directions are given for the bleaching operations using S, H_2O_2 or Na_2O_2. Other processes which can be employed for bleaching of wool involve the use of $KMnO_4$ with SO_2, the Blankite method, chalking by means of chalk or $BaCl_2$. Sp. precautions are given. (From *C. A.*, 1935, V. 29, Col. 8343.) (W)

WOOL: EVALUATION OF THE NEW TEXTILE ASSISTANTS IN THE WASHING OF—PREVIOUS TO FINISHING. E. Franz. *Mell. Textilber.*, 1935, V. 16, P. 277–82; *C. A.*, 1935, V. 29, Col. 6066. (W)

WOOL: FAST DYEING OF. Sigurd Köhler. *Medd. Statens Provning. Stockholm*, 1932, No. 55, P. 1–9.

Many of the indigo dyes used in dyeing wool fade when exposed to light. This bleaching effect is caused by a special treatment used in many industries. In order to obtain a water-sol. indigo dye, the indigo powder is treated with concd. H_2SO_4. The sulfonic acid of indigo thus formed gives the wool a blue color, which, however, is not fast to light. (From *C. A.*, 1935, V. 29, Col. 6430.) (W)

WOOL FIBRE: INFLUENCE OF DETERGENTS ON. Fritz Ohl. *Spinner. u. Weber*, 1934, V. 52, No. 28, P. 9–12.

Tests were made and described for cleaning action and damaging action on the fibre of calcined soda, Lux soap and Persil. (From *C. A.*, 1935, V. 29, Col. 8343.) (W)

WOOL: INFLUENCE OF THE VARIOUS GRADES OF ARTIFICIAL SPINNING FIBRES ON THE DYEING PROPERTY IN MIXTURES OF THESE FIBRES WITH. H. Gurlt. *Deut. Wollen-Gewerbe*, 1935, V. 67, P. 605; *C. A.*, 1935, V. 29, Col. 8338. (W)

WOOL: STICKING OF IRON TO—IN DYEING. K. Kataoka, M. Waki and T. Irie. *J. Soc. Chem. Ind., Japan* 38, Suppl. binding, 1935, P. 322–3.

Reddish brown dirt spots on dyed woolen cloth were identified as an iron compd. and were not caused, as commonly believed, by the fatty substances of the textile soap used. The staining can be avoided by using a suitable amt. of Na_2CO_3 in the dyeing process. Exptl. results are presented. The quantities of Fe which adhered in scouring were found to be generally proportional to the I nos. of the fats and oils in the soap. (From *C. A.*, 1935, V. 29, Col. 6430.) (W)

IV. RESEARCH METHODS AND APPARATUS

ALKALI: USE OF METHYL GREEN FOR DETECTING TRACES OF—IN FIBROUS MATERIALS. Ellis Clayton. *J. Soc. Dyers Col.*, 1935, V. 51, P. 387–8.

A dil. soln. of methyl green (0.1% No. 684), especially when used at a temp. of 80–100°, is a good reagent for the detection of minute traces of alkali in textile fibres. A standard 0.1% soln. in distd. water was prepd. One cc. of this soln. in 200 cc. distd. water was practically unaffected when boiled in a Pt basin for 30 sec., with similar results when repeated in the presence of 0.25 g. purified wool. One cc. of a 0.1% soln. of methyl green, 200 cc. distd. water and 0.25 cc. 0.01 *N* NaOH become decolorized almost completely on boiling. (From *C. A.*, 1936, V. 30, Col. 619.) (W)

APPARATUS FOR MEASURING THE STRENGTH-ELONGATION PROPERTIES OF YARNS AND FIBRE. A. J. Hall. *Tex. Col.*, Jan. 1936, P. 40–43, 60.

Describes constant loading apparatus devised by H. S. Cliff (*J. T. I.*, 1933, *24*, T351), D. Demeulemeester and I. Nicoloff (*J. T. I.*, 1935, *26*, T147), and I. J. Saxl (*Tex. Rsch.*, 1935, *5*, 519).

Also described is the constant-rate-load apparatus for measuring fibre extension of Lonsdale (*J. T. I.*, 1923, *14*, T248) which in turn is a modification of apparatus previously designed by Shorter and Hall (*J. T. I.*, 1923, *14*, T493), and also that of R. L. Steinberger (*Tex. Rsch.*, 1935, *5*, 207, 271). (C)

BURSTING TEST ON KNITTED FABRICS. W. Davis and C. H. Edwards. *J. T. I.*, Jan. 1936, P. T13–24.

A series of experiments was made using the "Mullen Tester" and also an experimental bursting test machine designed to work from an ordinary pressure water supply. This machine can be adapted to take various sizes of test piece of fabric up to a 7-in. diameter and is fitted with a device to measure the central rise of the diaphragm. An elementary theory of the machine is discussed and developed, indicating how the actual tension in the fabric and its area extension may be approximately calculated; experimental evidence is offered in support of this theory. The rate of loading has been examined and found not to influence the results below a certain critical speed. Curves have been obtained for the rate of increase of pressure and extension, and the latter is found to be almost constant throughout a test. Results obtained from the Mullen tester confirm that its use is limited to comparative measurements and that an estimated correction for diaphragm pressure is essential. Some miscellaneous readings for typical knitted fabrics have been included, together with information concerning the relation of the tightness of fabric texture to bursting strength. (C)

COLORED SURFACES: DISK COLORIMETRY. Dorothy Nickerson. *J. Opt. Soc. Am.*, 1935, V. 25, P. 253–7.

Information required for careful work with the disk method of colorimetry is provided. Figures for color differences significant in cotton grading are given as a basis for the comparison of the significance of the other differences. (From *J. T. I.*, Nov. 1935, P. A592.) (C)

CREASE-RESISTING PROPERTY OF FABRICS: DETERMINATION OF. *J. Soc. Dyers Col.*, 1936, Jan., P. 38; Mar., P. 117.

An interesting method of estimating the degree of resistance to creasing of fabrics is carried out as follows: A strip of the fabric 4 cm. long by 1 cm. wide is folded and placed under a weight for 3 min. It is then removed and placed on its edge on the surface of a bath of mercury, and its length measured to obtain the amount of straightening out by its own elasticity after an interval of 2 min. and compared with its original length. The test is repeated with a strip cut from the opposite direction of the fabric. The strip should be protected from draughts or other disturbing factors during the test. We have been informed that this method is due to the British Cotton Industry Research Association. (C)

ELECTRICAL METHOD FOR MEASURING THE MOISTURE CONTENTS OF FABRICS. J. L. Spencer-Smith. *J. T. I.*, Nov. 1935, P. T336–40; *Tex. Mfr.*, 1935, V. 61, P. 494.

The moisture content of textile fabrics has considerable effect upon such physical properties as tensile strength, elasticity, rigidity, etc. An electrical instrument is described that is capable of measuring the moisture content of textile goods and suitable for routine testing by more or less unskilled workers. (C)

ENZYMATIC DESIZING AGENTS: EVALUATION. Kehren. *Mell. Textilber.*, 1935, V. 16, P. 875–8.

Although the activity of an enzymatic desizing agent depends upon its amylase content, and various methods are described in the literature for determining the latter, the amylase content provides no real indication of the behavior of the enzyme under different conditions encountered in actual practice. The suitability of a diastatic ferment for any particular purpose, therefore, can only be determined from a series of trials under specially prescribed conditions. Such conditions are described. (From *J. Soc. Dyers Col.*, Feb. 1936, P. 79.) (C)

LOOMS PER WEAVER. L. P. Alford. *Tex. Wld.*, Jan. 1936, P. 72–3.

Abstract of a report to the American Society of Mechanical Engineers by the chief of the engineering staff of the silk board, which was one of the Winant work-assignment boards, now officially abandoned. As a result of the valuable data assembled by this "silk board" an A. S. M. E. committee was set up to consider the inauguration of an all-industry study of the problem of reasonable work assignment. (C)

LUSTRE OF TEXTILES. G. S. Ranshaw. *Tex. Mfr.*, Feb. 1936, P. 52.

Describes the Carl Zeiss photometer and glossimeter for the numerical measurement of lustre of textiles, and explains the principles upon which the operation of the instrument is based. (C)

MEASUREMENT OF THE UNIFORMITY OF WORSTED YARN AND ROVING BY MEANS OF THE PHOTO CELL. E. Franz and H. J. Henning. *Mell. Textilber.*, 1935, P. 710; *Rayon & Mell.*, Feb. 1936, P. 86.

The authors deal especially with the uniformity of the thread weight and therewith of the yarn thickness and have constructed a special apparatus for checking that characteristic which operates with a photo cell. The next part of the article will describe the newly designed counting mechanism. (C)

MICROSCOPIC OBSERVATION OF THE ELECTROPHORESIS OF DYES, ETC., WITH CELLOPHANE AS SEMI-CONDUCTOR. H. H. Waelsch. *Kolloid Z.*, 1935, V. 73, P. 36–9.

A method is described for determining the nature and size of electric charge on dyes, etc., in which moist Cellophane is used as a semi-conductor, as well as a modification of the macroscopic method of demonstrating the migration of dye particles in an electric field. (From *J. Soc. Dyers Col.*, Dec. 1935, P. 425.) (C)

MILL LABORATORY: PRACTICAL RESEARCH AND ACCURATE TESTING ARE TRUE FUNCTIONS OF REAL MAINTENANCE. H. D. Evans. *Cotton*, Feb. 1936, P. 73–7.

An excellent description of a well-equipped and staffed laboratory for control of raw materials and mill processes, the studying and checking of new methods or modifications of existing methods, and the investigation and correction of defects in products that may be detected in the mill or through complaints from customers. The author is research director of the Pepperell Mfg. Co., Biddeford, Me. (C)

OPTICAL INSTRUMENTS: APPLICATION OF—IN THE TEXTILE INDUSTRY FOR ROUTINE AND RESEARCH. J. H. Schering. *Am. Dye. Rptr.*, Feb. 24, 1936, P. 96. (C)

PAPER TESTING: DEVELOPMENTS IN—DURING 1935. B. W. Scribner. *Paper Trade J.*, Jan. 30, 1936, P. 43.

The bibliography includes a number of physical and chemical tests adapted for textiles, particularly fibres of cellulose base. (C)

RAPID PRECISION VISCOMETER. O. Fitzsimons. *Ind. Eng. Chem.; Anal. Ed.*, 1935, V. 7, P. 345–7.

The accuracy of the Saybolt viscometer and viscometers with long capillaries is compared and sources of error are discussed. A modification of Ubbelohde's suspended-level viscometer is described which is quicker in use than the Saybolt and more exact. Temperature control is by a vapor bath. (From *J. Soc. Dyers Col.*, Jan. 1936, P. 29.) (C)

YARNS: TENSILE TESTING. W. Frenzel. *Leipz. Monats. Text. Ind.*, 1935, V. 50, *Fachheft II*, P. 46–8.

The extension of warp yarns on the loom is discussed and it is pointed out that measurements of strength alone do not always give a satisfactory indication of the working capacity of yarns, especially rayon yarns, in weaving, knitting and similar operations. The Frenzel-Hahn tester is a convenient apparatus for the determination of the suitability of yarns for particular processes. In this device, the tensions in the yarns caused by extensions likely to be encountered in processing are measured. The results of tests on cotton, Vistra, linen and mixture yarns are shown and discussed. (From *J. T. I.*, Nov. 1935, P. A581.) (C)

V. ECONOMICS, PHYSICS AND MISCELLANY

CELLULOSIC MEMBRANES: STRUCTURE AND SELECTIVE PERMEABILITY. W. Wilbrandt. *J. Gen. Physiol.*, 1935, V. 18, P. 933–65.

An attempt is made to reconcile the two existing theories of the mechanism of selective ion permeability of the cell membrane by taking into account the molecular arrangement in the substance of the membrane. It is shown that the pore theory and the solubility theory are not contradictory, but are two aspects of the same problem, one from the thermodynamic point of view, the other from the point of view of molecular theory. (From *J. T. I.*, Nov. 1935, P. A596.) (C)

ELECTRON TECHNIC: DEVELOPMENT OF—AND ITS IMPORTANCE FOR THE TEXTILE INDUSTRY. Rudolf Mehlo. *Monatschr. Textil-Ind.*, 1935, V. 50, P. 217, 240.

A discussion of the applications of high-vacuum tubes and Hg vapor rectifiers. (From *C. A.*, 1936, V. 30, Col. 293.) (W)

MECHANICAL CALCULATION OF STANDARD DEVIATIONS AND CORRELATION EFFICIENTS. G. A. R. Foster. *Shirley Inst. Memoirs*, Nov. 1935, P. 27–42; *Cotton Literature*, Feb. 1936, P. 54. (C)

TEXTILE MICRO-CHEMICAL METHODS. W. Garner. *Tex. Mfr.*, 1936, Feb., P. 68; Mar., P. 111.

The author describes micro-chemical analyses and tests that have been developed to a position where they are fairly simple to apply and are worthy of the attention of textile chemists. (C)

WASTE LIQUORS AND GASES OF THE PAPER INDUSTRY. *Paper Trade J.*, Jan. 16, 1936, P. 31.

Conclusion of a survey of recent domestic and foreign patent literature on the utilization of waste liquors and waste gases of the pulp industry, 1931–35; includes subject and author indexes. (C)

YOUNG'S MODULUS DETERMINATION APPARATUS. J. M. Ide. *Rev. Sci. Instr.*, 1935, V. 6, P. 296–8.

A method of measuring Young's modulus that is believed to be more sensitive and more general in application than previously suggested dynamic methods involves setting the specimen into vibration by electrostatic traction, determination of the natural frequency of longitudinal vibration and computation of the Young's modulus therefrom. (From *J. T. I.*, Jan. 1936, P. A34.) (C)

CATAPHORESIS OF PARTICLES OF THE FATTY ACIDS AND RELATED COMPOUNDS. T. Alty and O. Johnson. *Phil. Mag.*, July 1935, P. 129–45; *Science Abs.*, Sept. 1935, Col. 3249. (X)

CAUSE OF LOW MECHANICAL STRENGTH. A. Joffe. International Conference on Physics, London, 1934, V. II. Solid State of Matter. P. 72–6.

The large discrepancy between observed and calculated tensile strengths of crystalline substances is also exhibited by amorphous bodies such as glass. Two kinds of rupture are to be distinguished: (1) plastic, in which there is reduction of area at some place before rupture; and (2) brittle rupture. Brittleness occurs when the elastic limit reaches the practical tensile strength. Experiments are described to illustrate the importance of surface conditions on tensile strength and the conclusion reached is that practical weakness is essentially due to sharp surface discontinuities. (From *Science Abs.*, Sept. 1935, Col. 3278.) (X)

CHEMICAL FORCES FROM THE STANDPOINT OF QUANTUM MECHANICS. Part II. W. Jost. *Z. f. Elektrochem.*, Sept. 1935, P. 667–74.

Part I contained a qualitative treatment of the homopolar chemical bond and the present paper reviews attempts at furnishing a quantitative expression for the known properties of the bond. (From *Science Abs.*, Oct. 1935, Col. 4049.) (X)

ELASTIC REACTION: THEORY OF. P. Vernotte. *Compt. Rend.*, June 17, 1935, P. 2058–61.

It is suggested that the properties of elastic materials are such that the return to the position of equilibrium after deformation is the result of opposed distributions of elasticity and viscosity. (From *Science Abs.*, Sept. 1935, Col. 3293.) (X)

FILMS BUILT BY DEPOSITING SUCCESSIVE MONOMOLECULAR LAYERS ON A SOLID SURFACE. Katharine B. Blodgett. *Am. Chem. Soc. J.*, June, 1935, P. 1007–22; *Science Abs.*, Sept. 1935, Col. 3331. (X)

GELATIN: EXISTENCE OF DIFFERENT FORMS. N. Peskoff and N. Zürupa. *Kolloid Z.*, 1935, V. 71, P. 73–9; *J. T. I.*, Sept. 1935, P. A474. (C)

GELATIN: FRACTIONATION. I. N. Putilowa and S. M. Liepatoff. *Kolloid Z.*, 1935, V. 71, P. 80–2, 83–7; *J. T. I.*, Sept. 1935, P. A474. (C)

PHYSICAL PROPERTIES OF SURFACES. PART II. VISCOUS FLOW OF LIQUID FILMS. RANGE OF ACTION OF SURFACE FORCES. S. H. Bastow and F. P. Bowden. *Roy. Soc. Proc.*, Aug. 1, 1935, P. 220–3; *Science Abs.*, Sept. 1935, Col. 3337. (X)

SEWAGE CONTAINING TRADE WASTES: CHEMISTRY OF. J. M. Wishart. Demonstrations of Analytical Methods and Tests. M. Lovett. *Surveyor, Lond.*, 1935, V. 87, P. 309.

Paper presented to the Institute of Sewage Purification, Feb. 1935, deals with the constitution and effect on sewage treatment of textile and other waste waters. (From *J. T. I.*, June 1935, P. A322.) (C)

SIZING OF PAPER: PROGRESS IN THE REALM OF—IN THE YEARS 1929–1934. Ernt Hochberger. *Papier-Fabr.*, Feb. 17, 1935, P. 49–60.

The important facts from each of the references are briefly discussed. (From *Paper Trade J.*, Dec. 26, 1935, P. 42.) (C)

TEXTILE RESEARCH: ORGANIZATION AND PROGRESS IN THE UNITED STATES. H. DeW. Smith. *Mncr. Guard Comm. "World Textiles" Number*, 1935, P. 21, *J. T. I.*, Dec. 1935, P. A655. (C)

TEXTILE RESEARCH: RECENT PROGRESS. *Mncr. Guard. Comm. "World Textiles" Number*, 1935, P. 19–20; *J. T. I.*, Dec. 1935, P. A655. (C)

Book Reviews

PHYSICO-MECHANICAL PROPERTIES OF RAW BAST FIBRES. I. V. Kraghelsky. Edited by V. P. Dobychin. (Russian.) New Bast Fibres Research Institute, Moscow, U. S. S. R. Pp. 300. Illustrated.

Kraghelsky's book is devoted to the study of physico-mechanical properties of raw bast materials (stems, bast, fibres). Its main distinction is that, instead of the usual descriptions of various testing devices and methods, it contains a mechanical analysis of technologic processes of raw bast fibre treatment. Proceeding from theoretical premises the author shows the rôle and the importance of various physico-mechanical properties. When analyzing the technologic process of degumming the author puts forward for the first time the determination of cohesive force of bast with wood (the power of attachment of bast to wood). When dealing with the process of decorticating the author gives the analysis of this process, taking into consideration the brittleness of stem and determining it by the angle of stem

fracture. When analyzing the process of drawing the author makes apparent the influence of fibre length variation upon the quality of resulting products. The static analysis of yarn construction leads to a formula permitting determination of the twist coefficient from the physico-mechanical properties of the fibre. The fourth chapter was written by the editor of the book and contains a full exposition of the physical properties of the fibres, of the theory of staple analysis, and of fibre splintering. Of particular importance is the final chapter which is devoted to evaluation of fibre by spinning count (Scuch's method, etc.). Reference lists of source material are given with each of the ten chapters, a large number of the references being English and American. (C)

STAPLE FIBRE SPINNING. Dr. H. G. Bodenbender. (German.) Pp. 480 with 212 illustrations. Berlin, Steglitz: Chem.-tech. Verlag Dr. Bodenbender, 1936. Price, Germany 18 Rm., other countries 13.5 Rm.

This is the first book to appear dealing with the production of all types of staple fibres, and the spinning of yarns and manufacture of fabrics containing these fibres. Sizing and desizing, bleaching, dyeing, printing, delustering, anti-crease process, waterproofing, etc., and mechanical finishing processes are described, also methods of testing the properties of the resulting materials and the purposes for which particular types of materials containing staple fibre are used. The text is illustrated by examples of the machinery used at all stages of manufacture and the apparatus required for control tests, diagrams and tables, and by photographs of various kinds of finished textile materials in which staple fibre is used. (C)

PROFITS AND LOSSES IN TEXTILES: COTTON TEXTILE FINANCING SINCE THE WAR. Stephen Jay Kennedy. Pp. 257. Price $3.50. Harper & Bros., New York and London.

Presents very fully, fairly, and also interestingly the financial trends of the industry since 1918, including analyses of more than 40 of the most important textile mergers and their experiences. Of equal importance are the chapters devoted to an interpretative survey of "Proposed Roads to Recovery" and "Present Trends." In the latter, and also in his analysis of the causes of complete or partial failure of cotton textile mergers, the author deals with controversial subjects in an eminently fair and dispassionate manner. Banker, investor, merchant and manufacturer interested in the future of the domestic cotton textile industry should find this book invaluable as a basis for accurately orienting their opinions as to the industry's future; and not only that of the cotton but of other branches of the textile industry, for the economic problems of all are very similar. The author is in charge of the market research department of Pacific Mills, but, as stated in the preface, the book was an independent study, and we understand that it was his Ph.D. thesis at Columbia University. (C)